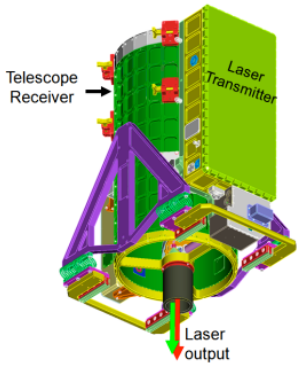
Observations of Cloud-Aerosol Halos During CHAPS/CLASIC



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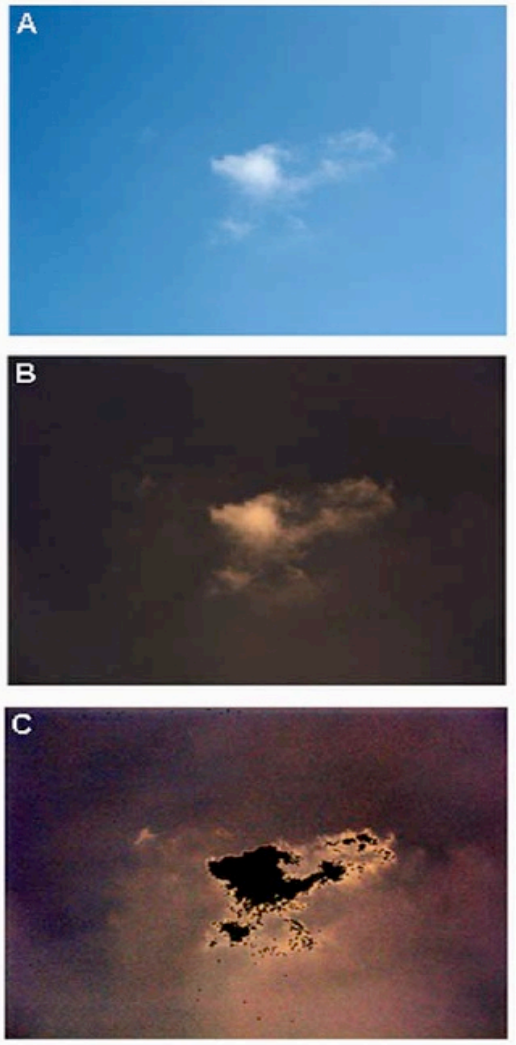
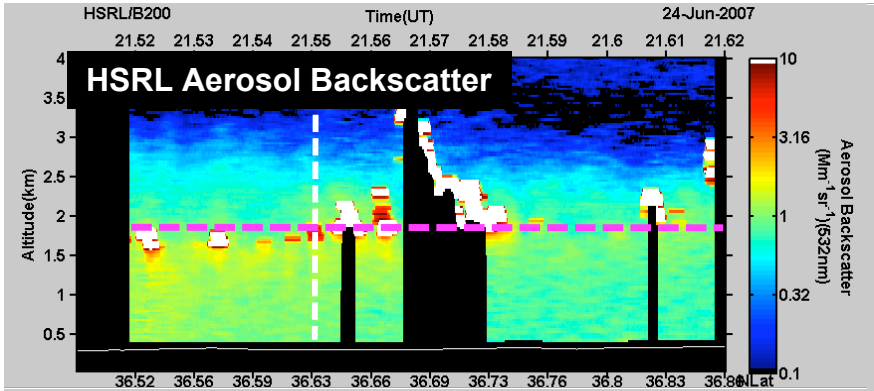
Motivation

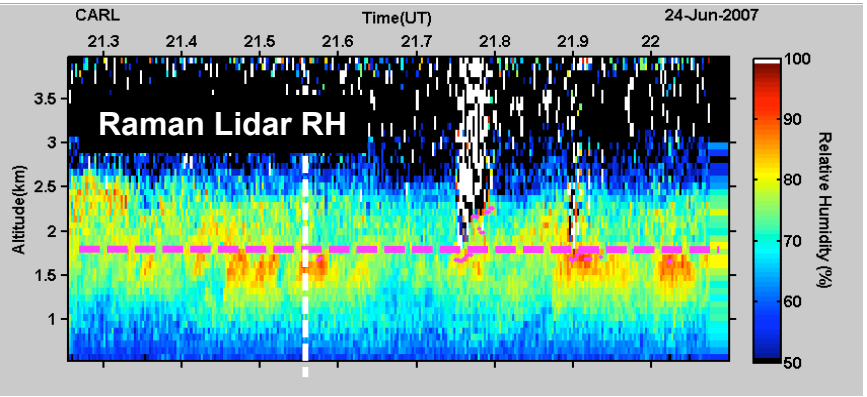
- Satellite, airborne, and surface sensors have noted significant changes in aerosol properties in transition zones near clouds ("Twilight Zone", Koren et al., 2007)
  - Area of forming/evaporating cloud fragments and hydrated aerosols
  - Increase in aerosol optical thickness (5-25%) has been observed in such zones
- Satellite-derived estimates of DARF will be biased 35-65% low unless these estimates correctly sample the regions within a few kilometers from clouds where humidification of aerosols increases AOD (Twohy et al., JGR in press)
- Questions:
  - On what spatial scales do aerosol properties change near clouds?
  - How are these effects related to hygroscopic growth, increased particle production, in-cloud processing, etc.?
  - How do we interpret satellite observations of such zones given 3-D cloud radiative effects, sample bias, etc. ?
- We use combination of advanced ground (SGP Raman Lidar) and airborne (NASA/LaRC HSRL) lidars, and airborne in situ measurements (G-1, Twin Otter) to address these questions

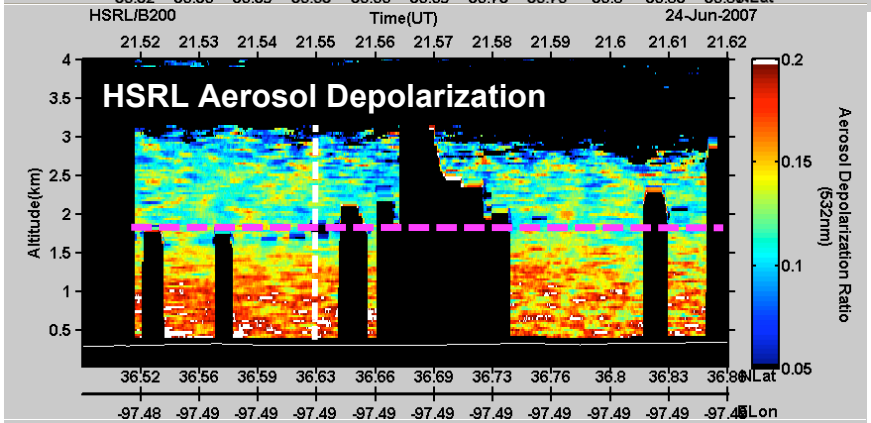


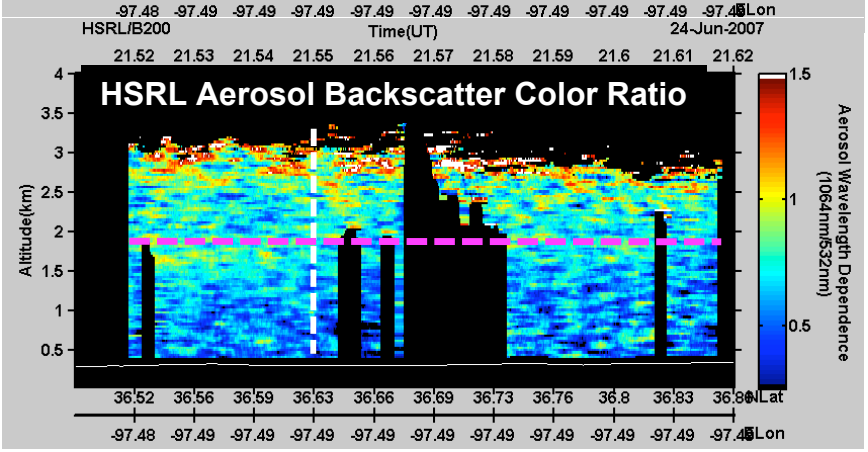
Koren et al., 2007

Changes in aerosol properties and RH near clouds









- Airborne NASA LaRC HSRL, ARM SGP ground-based Raman Lidar, and airborne in situ data from G-1 and CIRPAS Twin Otter are used to study spatial variations of aerosol optical properties near clouds
- Aerosol properties and RH adjacent to cloud edge are compared with properties some distance away from cloud edge
- Several altitudes above/below cloud base are examined

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Results

- Changes in extensive aerosol parameters seem consistent with observed increase in RH near cloud
  - Increases in relative humidity (5-10%) near clouds
  - Increases in aerosol backscatter (20-30%) and optical depth (8-17%) near clouds (within few km)
  - No clear systematic behavior in lidar ratio and backscatter color ratio near clouds
  - Aerosol humidification alone cannot explain variation in intensive aerosol properties (e.g., extinction/backscatter)
  - Combination of both remote sensing and in situ observations required to understand aerosol-cloud interaction and impact on forcing. More work planned with these data sets. (See Ferrare poster.)